SAVING ENERGY
Teacher Guide

NEED
2009-2010
Putting Energy into Education

NEED Project PO Box 10101 Manassas, VA 20108 1-800-875-5029 www.NEED.org

MESSAGE TO THE TEACHER

Dear Educator:

This ***Saving Energy*** program provides energy-related classroom materials that are correlated to the National Science Education Content Standards and to state and local level guidelines. NEED's materials and programs have been reviewed by teachers for effectiveness, and are currently in use in schools across the country. The NEED curriculum assists teachers in meeting their energy standards and assists families and schools in efforts to reduce energy consumption.

The Home Energy Efficiency Kits that accompany this guide help students take the lessons they are learning in the classroom to their homes. The kits include items designed to help reduce electricity and natural gas use at home and give students and their families a chance to see how even small measures can make a substantial difference in reducing energy use.

In the classroom, you and your students together will use the Classroom Companion Kit, and students and their families can apply classroom lessons with the Home Energy Efficiency Kit. Students will learn about heat, light, electricity, natural gas and much more. They will learn about ways to make simple changes that can save valuable natural resources and money on their utility bills.

The forms in this Teacher Guide allow you to assess student activities and to provide us with data to compile overall energy conservation behavior.

We are pleased you have chosen to participate in this exciting opportunity and encourage you to contact NEED with any questions you may have.

Thanks for being an Energy Saver!

Questions? Need kit materials?
Contact: The NEED Project
1-800-875-5029 or email info@need.org

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ADDITIONAL RESOURCES

SAVING ENERGY RESOURCES

Change the World, take the ENERGY STAR Pledge to do your part to save energy and help fight global warming. www.energystar.gov

ASK THE EXPERT

Students and teachers can email questions to an energy expert. www.eere.energy.gov/informationcenter

ASK A SCIENTIST

This online question-and-answer service for K-12 teachers and teachers was launched in 1991. Today Ask A Scientist receives more than one million hits each month. www.newton.dep.anl.gov/aas.htm

ENERGY INFORMATION ADMINISTRATION

The Energy Information Administration of the U.S. Department of Energy has up-to-date and historical information on energy consumption in many formats. www.eia.doe.gov

FIND YOUR EFFICIENCY ZONE

Based on the zip code entered, it will provide a comparison of the energy costs of an average home and an energy-efficient home in your area. http://homeenergysaver.lbl.gov

ALLIANCE TO SAVE ENERGY

Promotes energy efficiency worldwide for economy, environment and security. Offers K-12 lesson plans, energy saving tips and resource links. www.ase.org

UNIT TIMELINE

Three weeks before START of unit	Determine the number of students who will participate. If you need additional materials, call NEED at 1-800-875-5029.
Two weeks before START of unit	Familiarize yourself with the guides and the materials in the kits. Practice the experiments and investigations.
DURING unit	Collect forms as directed in the Teacher Guide.
END of unit	Collect forms as directed in the Teacher Guide. Complete Unit Evaluation Form. Allow students to take Student Guides home after collecting forms.
After END of unit	Send the following forms to NEED: Pre and Post Surveys from Student Guides Home Activities 3-1, 11-1, and 11-2 from Student Guides Evaluation Form from Teacher Guide **NEED Project** **8408 Kao Circle** **Manassas, VA 20110**

CLASSROOM SAVING ENERGY KIT CONTENTS

1 Set of 30 Student/Family Guides
1 Set of 30 Energy Savers Booklets
1 Set of Transparencies for teacher

4 Sets of Radiation Cans
8 Lab Thermometers
4 Student Thermometers
1 Incandescent Lightbulb
1 Compact Fluorescent Lightbulb
1 Kill-A-Watt Monitor
30 Rubber Bands
4 Rolls of Masking Tape
1 Bubble Wrap
1 Pitcher
1 Cellulose Fabric
1 Paper Insulation
1 Foam Insulation

STUDENT/FAMILY SAVING ENERGY KIT CONTENTS

Flow Meter Bag
Hot Water Gauge
Bathroom Sink Aerator
Refrigerator Thermometer
Roll of Teflon Tape
Nightlight
Outlet and Switchplate Gaskets
Low-flow Showerhead
Thermostat Temperature Guide
Kitchen Sink Aerator
Compact Fluorescent Lightbulbs

LESSON 1: SETTING THE STAGE—WHAT IS ENERGY?

OVERVIEW: This lesson reviews the forms and sources of energy and the production of electricity. Depending on the prior knowledge of your students, you may want to spend additional time on these topics using the Intermediate Energy Infobooks.

TRANSPARENCIES:
Forms of Energy (1-1)
Where Does My Car Get Its Energy? (1-2)
U.S. Energy Consumption By Source (1-3)
Energy Bucks Score Sheet (1-4)
Coal-fired Power Plant (1-5)

STUDENT GUIDE:
Forms of Energy 1
Energy Source Matching 1
Forms and Sources 1
Transporting Electricity1
The Energy I Used Today 1
Reflections 1
Connections 1
Pre-Survey

PROCEDURE

DISTRIBUTE: 1 Student/Family Guide, 1 Energy Savers Booklet, and 1 Intermediate Energy Infobook to each student.

INTRODUCE: The unit as a study of energy—what it is, where we get it, how we use it, and ways we can conserve it.

GO TO: The **Pre-Survey** on page 73 of the Student Guide and have the students complete the survey. Emphasize that it is a survey to find out what the students know, not a test, so the students should leave blank any questions they cannot answer. Tell the students that the survey will give them an idea of the things they will be learning in the unit.

INSTRUCT: The students to remove the completed surveys from their Student Guides. Collect and save them for evaluation.

DISCUSS: **What is energy? What does energy help us to do?**

LIST: The major things energy does—**heat, light, sound, motion, growth,** and **powering technology**—as column headings on the board and have the students give examples of each.

REVIEW: The forms of energy using the **Forms of Energy** (1-1) transparency and the same form on page 4 of the Student Guide.

DISCUSS: **Where do we get energy?**

LIST: Student responses on the board.

DISPLAY: **Where Does My Car Get Its Energy?** (1-2) transparency, using a piece of paper to cover all of the images except the car.

ASK : **Where does a car get the energy it needs to move?**

When 'gas pump' is named, uncover the picture.

ASK: **What fuel is being used by the car?**

When gasoline or diesel is named, uncover the picture of the well. Discuss petroleum products.

ASK: **Where is petroleum found?**

Petroleum is buried underground and under the oceans.

ASK: **How was petroleum formed?**

Uncover formation pictures: Petroleum was formed when tiny sea plants and animals died, were buried on the ocean floors and were compressed under heat and pressure over millions of years, turning them into oil (petroleum) and natural gas.

ASK: **Where did the sea plants and animals get the energy that was stored in them?**

Uncover top picture: Plants absorbed radiant energy from the sun and stored it in their cells as chemical energy.

DISCUSS: We have demonstrated an example of an energy flow. The energy from the petroleum (stored chemical energy) was used to provide energy for the car to move—motion energy.

LIST: Energy sources that students recall on the board.

REVIEW: The meanings of renewable and nonrenewable.

GO TO: **Energy Source Matching 1** on page 5 of the Student Guide. Instruct students to match each energy source with its definition. Review using Answer Key (1-1) on page 9 of Teacher Guide.

REVIEW: Using **U.S. Energy Consumption by Source** (1-3) transparency.

GO TO: **Forms & Sources 1** on page 6 of the Student Guide. Instruct students to complete the activity. Review using Answer Key (1-2) on page 11 of Teacher Guide.

DISCUSS: **How do we use energy?** List student responses on the board.

GO TO: **The Energy I Used Today 1** on page 7 of the Student Guide. Instruct the students to complete the activity by circling the energy activities or devices they used in the last 24 hours.

DISPLAY: **The Energy I Used Today (1-4)** transparency. Have the students add the energy bucks to their lists and add them together.

DISCUSS: The total energy bucks students used. A total of under 40 is considered very good in terms of energy savings. Ask students what they can do to reduce their use of energy.

ASK: **What is electricity? How is electricity produced?** List student responses on the board.

DISPLAY: **From Coal to Electricity (1-5)** transparency and explain how coal produces electricity.

DISCUSS: How electricity is produced by other energy sources in the U.S., such as other fossil fuels, uranium, hydropower, wind, solar, geothermal, and biomass. Discuss the energy sources in your area used to generate electricity.

GO TO: **Electricity Factsheet** in the Intermediate Infobook and have students use the factsheet to complete the **Transporting Electricity** activity on page 9 of the Student Guide. Review using Answer Key (1-3) on page 14 of the Teacher Guide.

EVALUATION: Have the students complete **Reflections 1** and **Connections 1** on pages 10-11 of the Student Guide.

Transparency 1-1

FORMS OF ENERGY 1

All forms of energy fall under two categories

POTENTIAL

Potential energy is stored energy and the energy of position (gravitational).

CHEMICAL ENERGY

Chemical energy is the energy stored in the bonds of atoms and molecules. Biomass, petroleum, natural gas, propane and coal are examples of stored chemical energy.

NUCLEAR ENERGY

Nuclear energy is the energy stored in the nucleus of an atom—the energy that holds the nucleus together. The nucleus of a uranium atom is an example of nuclear energy.

STORED MECHANICAL ENERGY

Stored mechanical energy is energy stored in objects by the application of a force. Compressed springs and stretched rubber bands are examples of stored mechanical energy.

GRAVITATIONAL ENERGY

Gravitational energy is the energy of place or position. Water in a reservoir behind a hydropower dam is an example of gravitational potential energy. When the water is released to spin the turbines, it becomes motion energy.

KINETIC

Kinetic energy is motion—the motion of waves, electrons, atoms, molecules and substances.

RADIANT ENERGY

Radiant energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Solar energy is an example of radiant energy.

THERMAL ENERGY

Thermal energy (or heat) is the internal energy in substances—the vibration and movement of atoms and molecules within substances. Geothermal energy is an example of thermal energy.

MOTION

The movement of objects or substances from one place to another is motion. Wind and hydropower are examples of motion.

SOUND

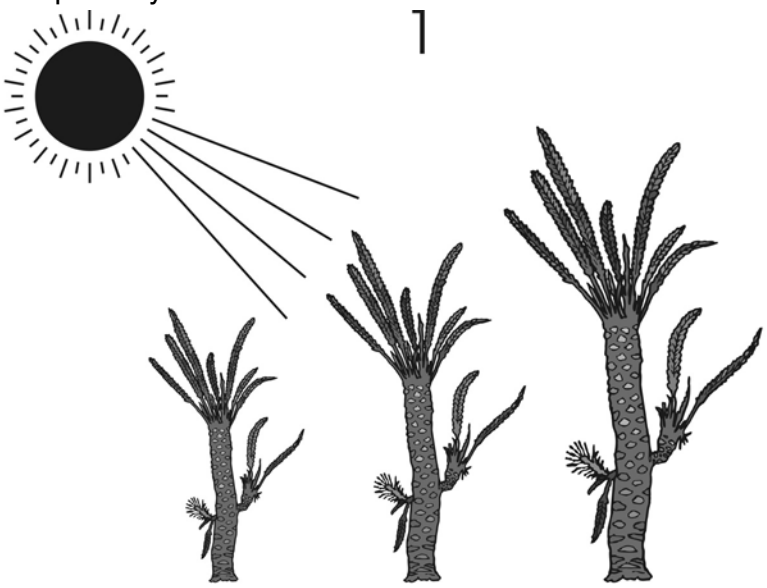
Sound is the movement of energy through substances in longitudinal (compression/ rarefaction) waves.

ELECTRICAL ENERGY

Electrical energy is the movement of electrons. Lightning and electricity are examples of electrical energy.

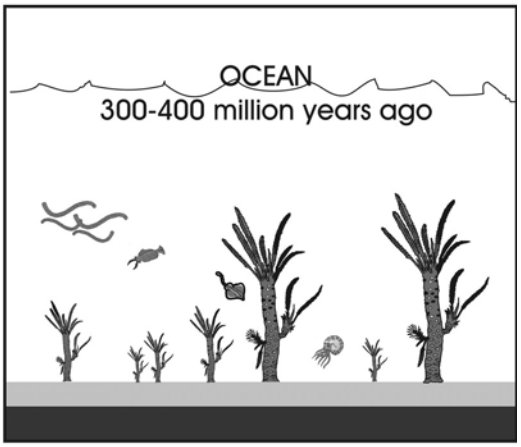
Transparency 1-2

1



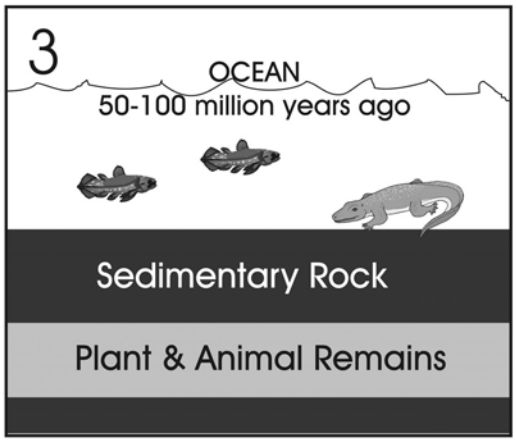
In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy and store it in their cells. When the plants die, much of this energy stays in their remains.

2



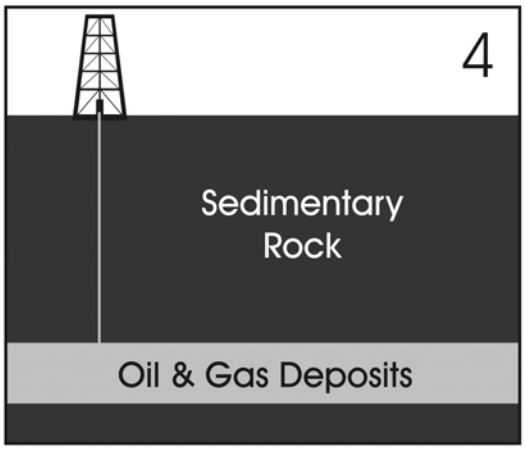
Tiny sea plants and animals died and were buried on the ocean floor. Over time, they were covered by layers of sand and silt.

3



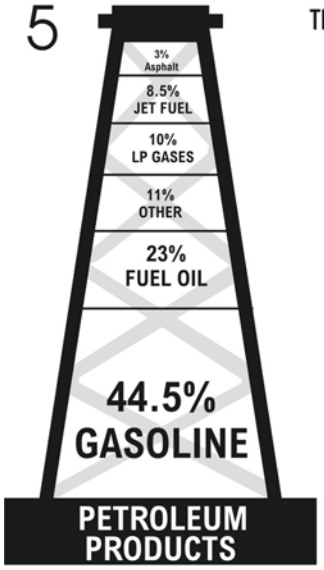
Over millions of years, the remains were buried deeper and deeper. The enormous heat and pressure turned them into oil and gas.

4



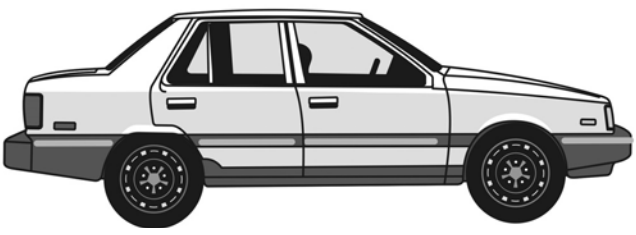
Today, we drill down through layers of sedimentary rock to reach the rock formations that contain oil and gas deposits. The crude oil is sent to refineries where it is made into many products.

5



6

7



Answer Key 1-1

ENERGY SOURCE MATCHING 1

Write the number of the energy source on the line next to its definition.

1. PETROLEUM	9	Black rock burned to make electricity.
2. WIND	7	Energy from heat inside the earth.
3. BIOMASS	8	Energy from flowing water.
4. URANIUM	3	Energy from wood, waste and garbage.
5. PROPANE	2	Energy from moving air.
6. SOLAR	4	Energy from splitting atoms.
7. GEOTHERMAL	5	Portable fossil fuel used in grills.
8. HYDROPOWER	1	Fossil fuel for cars, trucks, and jets.
9. COAL	10	Fossil fuel gas moved by pipeline.
10. NATURAL GAS	6	Energy in rays from the sun.

U.S. Energy Consumption by Source 2008

Source	Type	Uses	Share
PETROLEUM	nonrenewable	transportation, manufacturing	37.0%
COAL	nonrenewable	electricity, manufacturing	22.6%
NATURAL GAS	nonrenewable	heating, manufacturing, electricity	23.5%
URANIUM	nonrenewable	electricity	8.5%
PROPANE	nonrenewable	manufacturing, heating	1.0%
BIOMASS	renewable	heating, electricity, transportation	3.9%
HYDROPOWER	renewable	electricity	2.5%
GEOTHERMAL	renewable	heating, electricity	0.4%
WIND	renewable	electricity	0.5%
SOLAR	renewable	light, heating, electricity	0.1%

Answer Key 1-2

FORMS & SOURCES 1

The energy we use in the U.S. is mainly provided by the following sources of energy. Write the form of energy—in what form the energy is stored or delivered—for each of the sources on the line to the right.

RENEWABLES

Biomass: CHEMICAL

Hydropower: MOTION

Geothermal: THERMAL

Wind: MOTION

Solar & Other: RADIANT

NONRENEWABLES

Petroleum: CHEMICAL

Natural Gas: CHEMICAL

Coal: CHEMICAL

Uranium: NUCLEAR

Propane: CHEMICAL

What percentage of U.S. energy is provided by each form of energy? By renewables? Nonrenewables?

Motion: 3 %

Chemical: 88 %

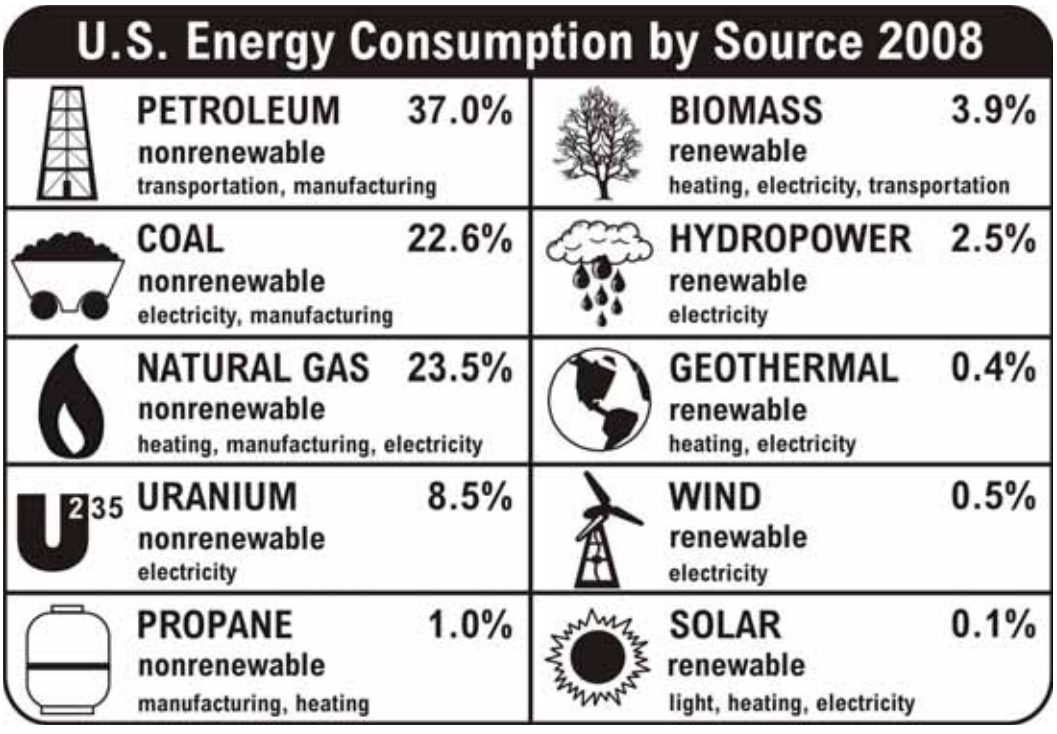
Radiant: 0.1 %

Thermal: 0.4 %

Nuclear: 8.5 %

Renewables: 7.4 %

Nonrenewables: 92.6 %



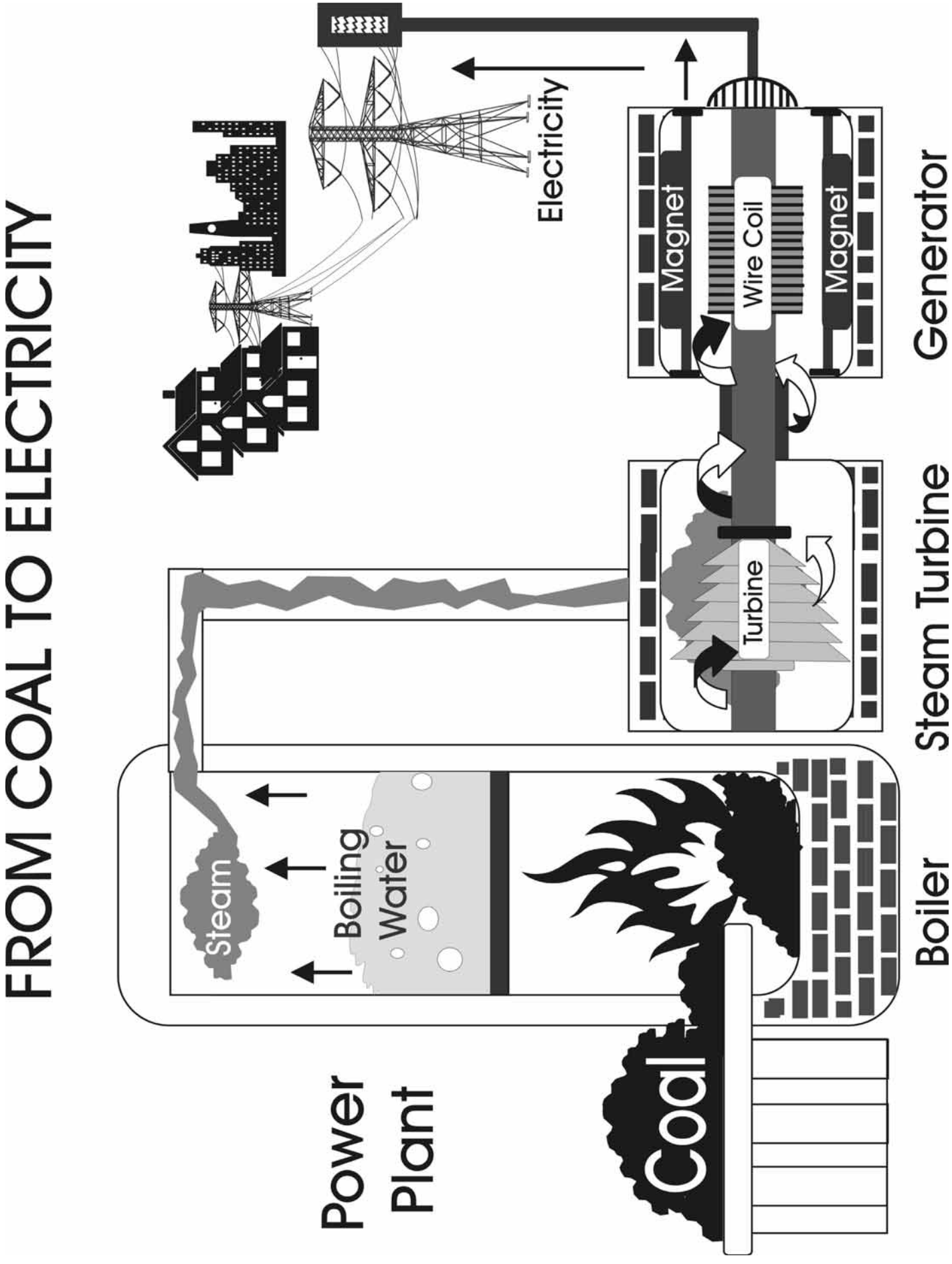
Transparency 1-4

THE ENERGY I USED TODAY

ENERGY BUCK VALUES

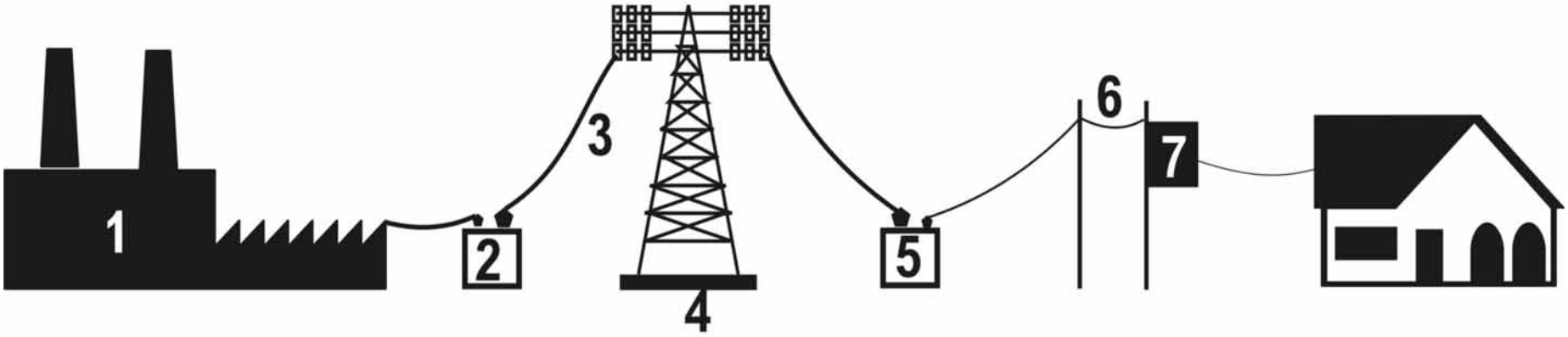
WAKING UP	
Alarm Clock or Radio	2
BREAKFAST	
Microwave	2
Stove/Oven	5
Toaster Oven	3
Refrigerator	3
READY FOR SCHOOL	
Air Conditioning/Heating	10
Radio/CD Player	2
TV/VCR/DVD Player	3
Shower/Bath	3
Hair Dryer	3
Curling Iron/Curlers/Straightener	3
ROOM LIGHTING	
Bedroom	2
Bathroom	2
Kitchen	2
Family room	2
Other	2
GETTING TO SCHOOL	
Walk	0
Bicycle	0
School Bus	1
Carpool	2
Family Vehicle	5
AFTER SCHOOL	
Air Conditioning/Heating	10
Travel in Vehicle	5
Lights	2
Computer	3
Video Game System	3
CD Player/Radio	2
TV/VCR/DVD Player	3
Telephone	1
Snack Preparation	2
LAST NIGHT	
Air Conditioning/Heating	10
Microwave	2
Stove/Oven	5
Toaster Oven	3
Refrigerator	3
Grill	2
Lights	2
TV/VCR/DVD Player	3
Shower/Bath	3
Hair Dryer	3

Transparency 1-5



TRANSPORTING ELECTRICITY 1

Explain what each of the components numbered below does to get electricity from the generator to the consumer.



1. **Power plant -** generates electricity
2. **Step-up transformer -** increases voltage to reduce transmission loss
3. **Transmission line -** transports high-voltage electricity over long distances
4. **Power tower -** carries transmission lines
5. **Step-down transformer -** lowers voltage for smaller distribution lines
6. **Distribution line -** carries lower voltage electricity to homes and businesses
7. **Neighborhood transformer -** lowers voltage to the voltage used by appliances in homes and businesses (120 & 240 volts)

LESSON 2: USING ENERGY AT SCHOOL

OVERVIEW: In this lesson, students investigate how energy is used at school.

MATERIALS: Erasable Overhead Marker, Notebook Paper, Pencils

TRANSPARENCIES: Legend (2-1)
Blank Grid (2-2)
Kitchen Example (2-3)
Building Inventory (2-4)

STUDENT GUIDE: Energy Use at School 2: My School, My Classroom, and My Work Area
Reflections 2

PREPARATION: Prior to the lesson, obtain permission for the students to investigate their assigned work areas.

Make several copies of the legend and post around the room so all students can see them.

Divide the class into four work area teams. Assign each team to one of the following areas: library, main office, gymnasium, and cafeteria.

PROCEDURE

INTRODUCE: Energy is usually the second largest expense in school districts after personnel costs.

DISCUSS: **How do schools use energy?**

LIST: Student responses on board. Make sure they include transportation, heating and cooling, lighting, cooking food, heating water, and running machines.

DISCUSS: **What factors affect the amount of energy schools use?**

LIST: Student responses on board. Make sure they include the size of the building; the number and efficiency of windows and doors; the number and type of lights; the number of machines and how energy efficient they are; the efficiency and temperature settings of the heating, cooling and water heating systems; the number of transportation vehicles, what fuels they use and how far they travel; how well systems are maintained; and how people in the building manage all of these factors.

INTRODUCE: The activities the students will be doing to investigate their school building and how their school uses energy—drawing diagrams of the school building, their classroom, and their work areas.

ACTIVITY: With notebook paper and pencils, have the students walk around the outside of the school building with supervision, making sketches of the shape of the building and the placement of doors and windows (on the first floor only). Return to the classroom when students have a good idea of the building.

DISPLAY: The **Legend (2-1)** transparency and explain the symbols.

DISPLAY: The **Blank Grid (2-2)** transparency and draw a simple diagram of the school building using the symbols for doors and windows.

DISCUSS: With the students what is accurate/inaccurate about your diagram, making changes until there is a consensus that the diagram is an accurate depiction of the school building.

GO TO: **Energy Use at School 2** on page 12 of the Student Guide. Have the students read the instructions, examine the example, then draw their own diagrams of the school on page 13 of the Student Guide. Instruct them to leave enough room around the outside of the diagram to add landscaping later.

DISPLAY: The **Kitchen Example (2-3)** transparency. Indicate the symbols used to represent doors, windows, electrical outlets, lights and energy-consuming appliances and devices. Indicate the copies of the **Legend (2-1)** displayed around the room and direct students to page 20 of the Student Guide showing the symbols.

GO TO: Page 14 of the Student Guide and have the students make their diagrams of the classroom, following the instructions to make sketches first on notebook paper.

ACTIVITY: Give students their work area assignments. With notebook paper and pencils, have each group go to its assigned work area and make sketches, then return to the classroom.

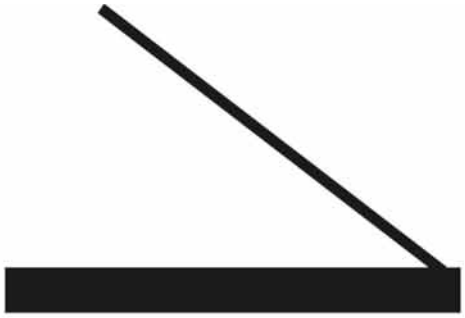
GO TO: Page 15 of the Student Guide, **My Work Area**, and have students draw their diagrams in their work groups.

GO TO: Page 16 of the Student Guide––**Reflections 2**––and have the students complete the questions at the top of the page.

DISPLAY: The **Building Inventory (2-4)** transparency. Fill in the chart with data from the work groups as the students complete the chart on the bottom of page 16.

DISCUSS: What the students have learned when completing the diagrams.

LEGEND



Door

Window

Light

Appliance or
Electrical Device

R - Refrigerator
S - Stove/Oven
DW - Dishwasher
MW - Microwave
W - Washer
D - Dryer

Ceiling Fan

Heating or
Cooling Device
or Vent

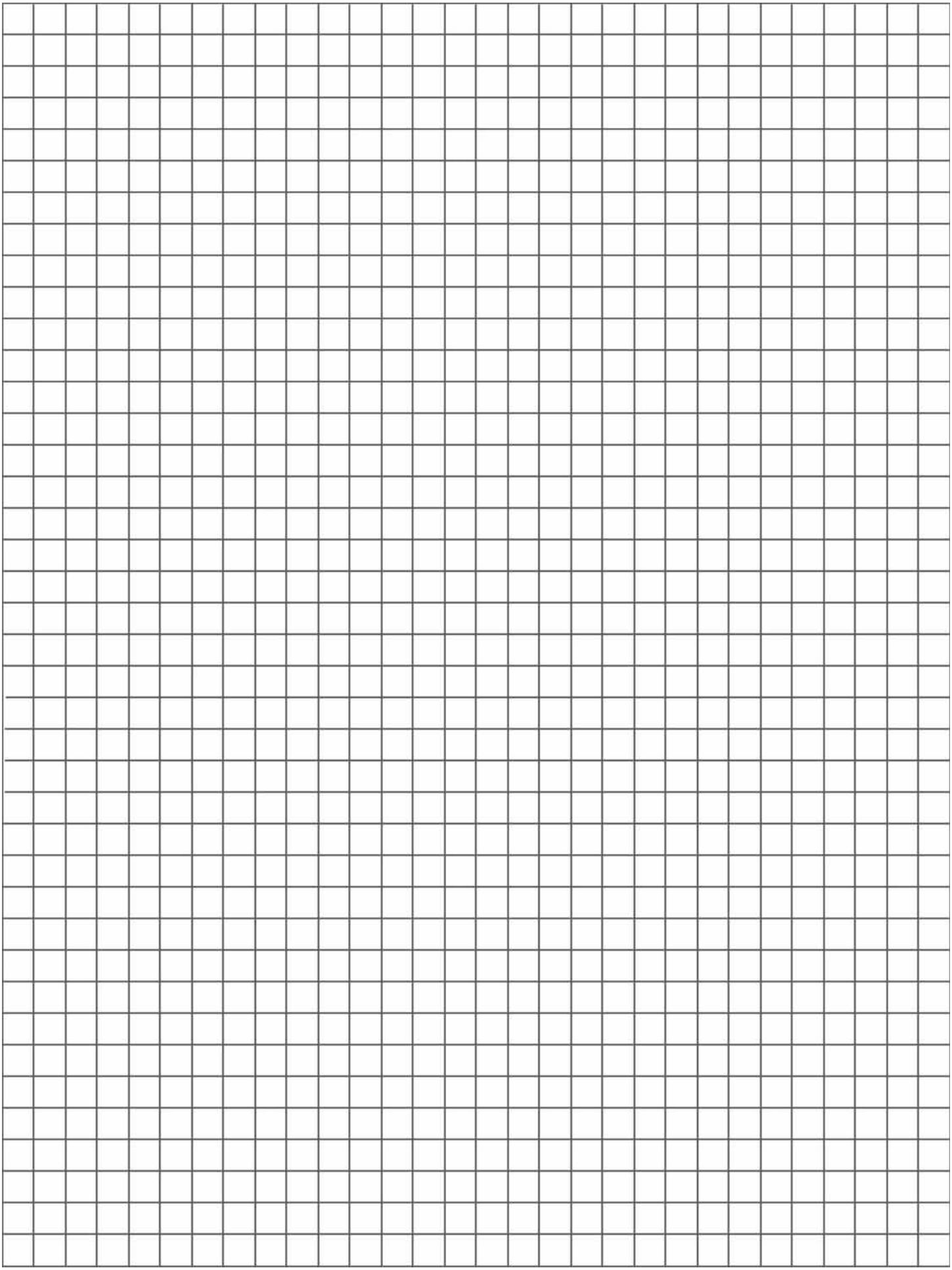
Utility Meter

Thermostat

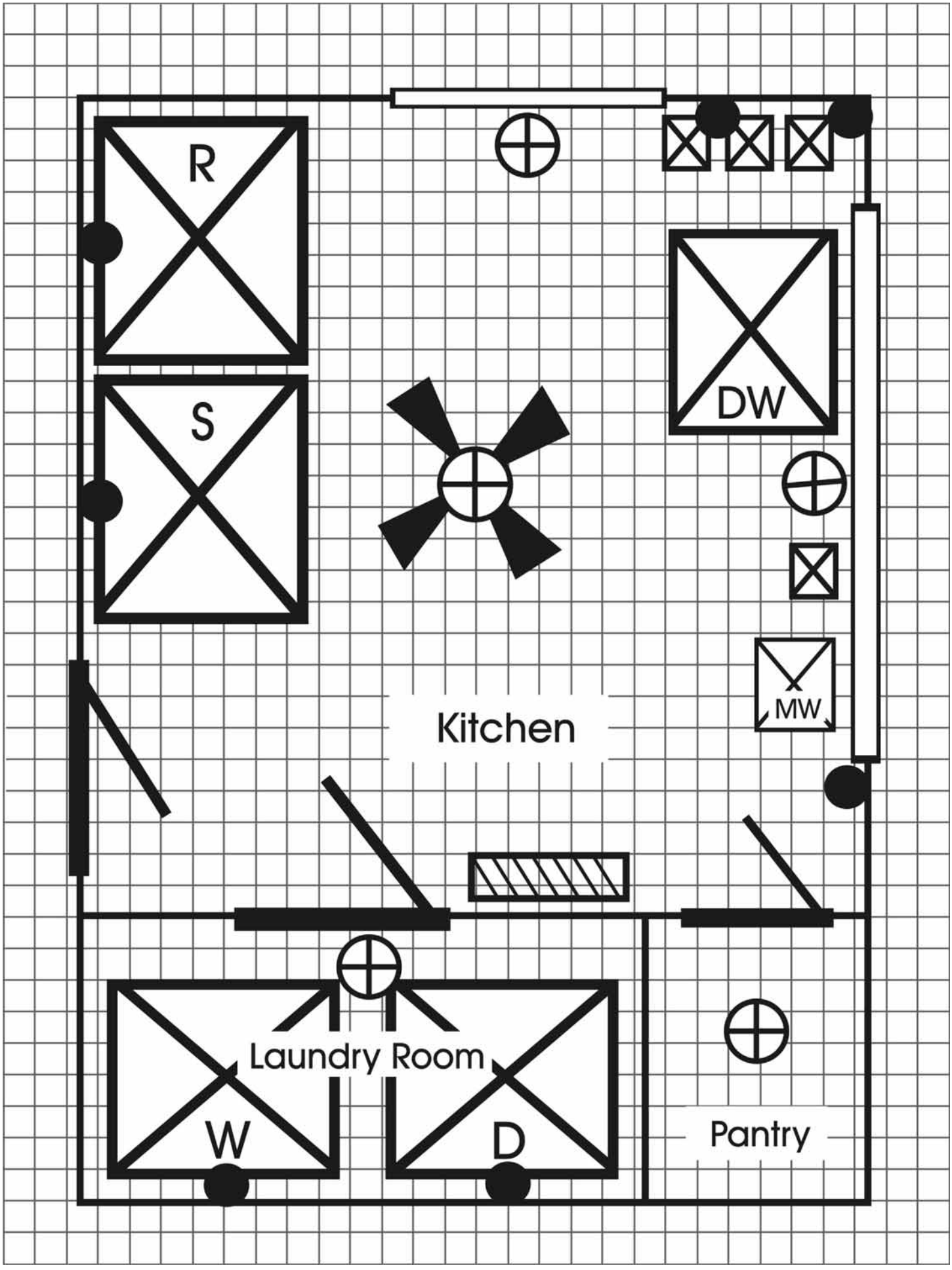
Water Heater

Electrical Outlet

Transparency 2-2



Transparency 2-3



BUILDING INVENTORY

LOCATION	DOORS	WINDOWS	LIGHTS	ELECTRICAL DEVICES	HEAT/COOL DEVICES/VENTS	ELECTRICAL OUTLETS	OTHER
Building							
Classroom							
Office							
Library							
Cafeteria							
Gymnasium							

LESSON 3: USING ENERGY AT HOME

OVERVIEW: In this lesson, students investigate how energy is used at home.

TRANSPARENCY: Classroom Survey Totals (3-1)

STUDENT GUIDE: Home Activity 3-1, Home Activity 3-2, Home Activity 3-3, Reflections 3, Connections 3

ENERGY SAVERS: Pages 1 – 3

PROCEDURE

INTRODUCE: The activities the students will be completing at home.

DISCUSS: **How is energy use at home the same as energy use at school? How is it different?**

LIST: Student responses on board.

GO TO: Pages 71 and 17-22 in the Student Guide and review the activities the students will complete with their families.

GO TO: Pages 1-3 of the Energy Savers booklet and review the information the students will read with their families.

ASSIGN: The activities and readings to the students and give them a completion date. (Completing the assignment over a week-end is more satisfactory than over one evening.)

REMIND: Students to take home their Student Guides and Energy Savers booklets and to bring them back on the completion date.

PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITIES

GO TO: **Home Activity 3-1** on page 71 of the Student Guide.

DISPLAY: The **Classroom Survey Totals (3-1)** transparency and add the totals from the student surveys to get the total figures. Calculate the average by dividing the totals by the number of participating students.

DISCUSS: With the students the things they learned by doing the activities with their families and their families' responses to the activities.

DISCUSS: With the students how their responses compare with the class averages.

EVALUATE: Have the students complete **Reflections 3** and **Connections 3** on pages 23-24 of the Student Guide.

Transparency 3-1

HOME SURVEY TOTALS

		TOTAL	AVERAGE
1. Number of incandescent lightbulbs.		_____	_____
2. Number of compact fluorescent lightbulbs.		_____	_____
3. Number of times dishwasher is run per week.		_____	_____
4. How often the Energy Saving feature is used.	0%	_____	_____
	25%	_____	_____
	50%	_____	_____
	75%	_____	_____
	100%	_____	_____
5. Number of loads of laundry washed per week.		_____	_____
6. Percentage of the laundry loads washed in cold water.	0%	_____	_____
	25%	_____	_____
	50%	_____	_____
	75%	_____	_____
	100%	_____	_____
7. Total number of baths taken each week.		_____	_____
8. Total number of showers taken each week.		_____	_____
9. Average length of each shower.		_____	_____
10. Thermostat settings:			
Cooling Season:	Day _____°F	_____	_____
	Night _____°F	_____	_____
Heating Season:	Day _____°F	_____	_____
	Night _____°F	_____	_____
11. How many times today:			
..... is a light left on in an unused room?		_____	_____
..... is a TV, radio, computer, or video game left?		_____	_____
..... is an outside activity, board game, or reading chosen?		_____	_____
..... is the water allowed to run needlessly?		_____	_____
..... is the microwave used to cook?		_____	_____
..... is a door or window open with heat or AC?		_____	_____

LESSON 4: MEASURING THE ENERGY WE USE

OVERVIEW: This lesson will help students understand how electricity and natural gas consumption are measured and teach them how to read utility meters.

TRANSPARENCIES:
Reading an Electric Meter (4-1)
Reading A Natural Gas Meter (4-2)
School Electricity and Natural Gas Meters (4-3)

STUDENT GUIDE:
School Utility Meters 4
Reading an Electric Meter 4
Reading a Natural Gas Meter 4
Home Activity 4-1
Home Activity 4-2
Reflections 4
Connections 4

PREPARATION: Schedule someone from the maintenance staff to accompany your students as they observe the school's electric and natural gas meters.

REAL LIFE OPTION: Find out from your local utilities the average cost of a kilowatt-hour of electricity and a therm of natural gas for residential and commercial customers. Use this data when calculating the cost.

PROCEDURE

INTRODUCE: The activity by discussing how different types of energy are measured.

ASK: What unit is used to measure the amount of gasoline we buy at a gas station? (gallon)

What devices measure the electricity and/or natural gas we use at school? (meters)

What unit of measurement is used to measure electricity? (kilowatt-hour)

What unit of measurement is used to measure natural gas? (therm)

DISPLAY: **Reading an Electric Meter (4-1)** transparency and explain how to read an electric meter, how to determine the amount of electricity used over time, and how to calculate the cost. (The national average for residential customers is $0.11/kWh and $0.10/kWh for commercial customers.)

GO TO: Page 25 in the Student Guide. Instruct the students to complete the form as you explain using the transparency. (See page 24 for answers.)

DISPLAY: **Reading a Natural Gas Meter (4-2)** transparency and explain how to read a natural gas meter, how to determine the volume of natural gas used over time, how to convert the amount of natural gas used into the amount of heat energy, and how to calculate the cost. (The national average for residential customers is $1.37/therm and $1.20/therm for commercial customers.) Meters measure the volume of natural gas used in CCF (hundred cubic feet), but utilities bill by therms—a measure of the amount of heat energy contained in the natural gas. One CCF of natural gas contains approximately one therm of energy. Larger consumers, such as industrial users, measure volume in MCF (thousand cubic feet).

GO TO: Page 26 in the Student Guide. Instruct the students to complete the form as you explain using the transparency. (See page 24 for answers.)

GO TO: Page 27 in the Student Guide if your school's meters have dials. If your school has digital meters, adjust the discussion accordingly. Instruct the students to take their guides and pencils with them to view the school's meters.

ACTIVITY: Have a member of the maintenance staff accompany the students to view the school's meters. Instruct the students to observe the spinning of the meter dials and record the readings on the meters.

DISPLAY: **School Electricity and Natural Gas Meters (4-3)** transparency and complete the meter faces with the readings from the students.

ASK: If we use more energy in the building, will the dials spin slower or faster?

GO TO: Pages 28-29 in the Student Guide—Home Activities 4-1 and 4-2—and review the activities with the students.

ASSIGN: The activities to the students and give them a completion date. ***The assignment may need to be modified for students who live in apartment buildings or other structures that do not have individual meters. Students without meters can use the information from students who do and research and explain how the electricity and natural gas are metered in their living situations, as well as how the costs are prorated and billed.***

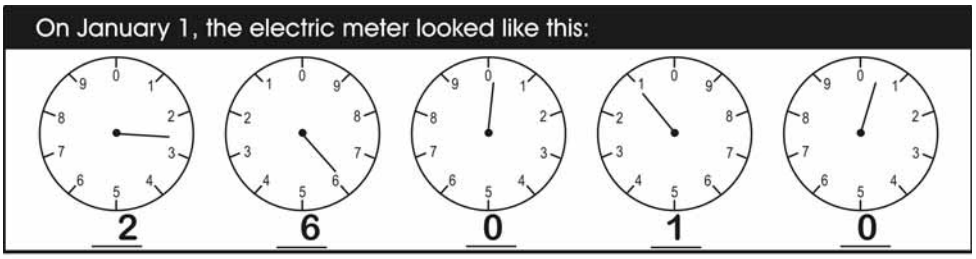
REMIND: Students to take home their Student Guides and to bring them back on the completion date.

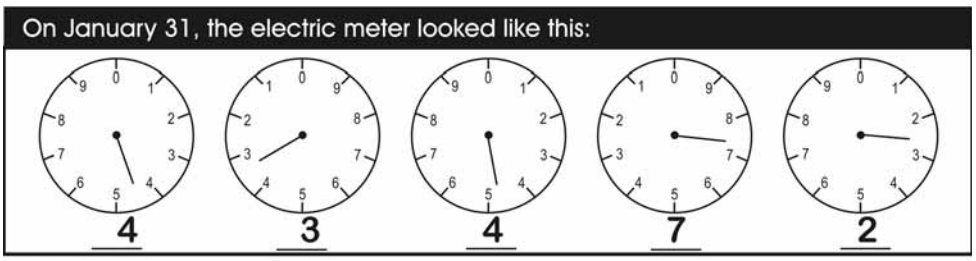
PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITY

DISCUSS: The activities with the students, comparing usage and answering any questions.

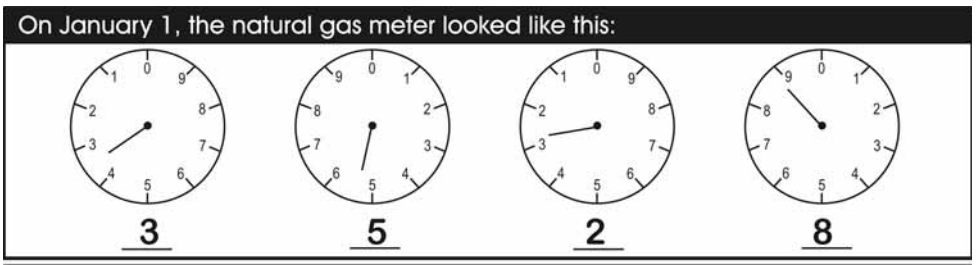
EVALUATE: Have the students complete **Reflections 4** and **Connections 4** on pages 30-31 of the Student Guide.

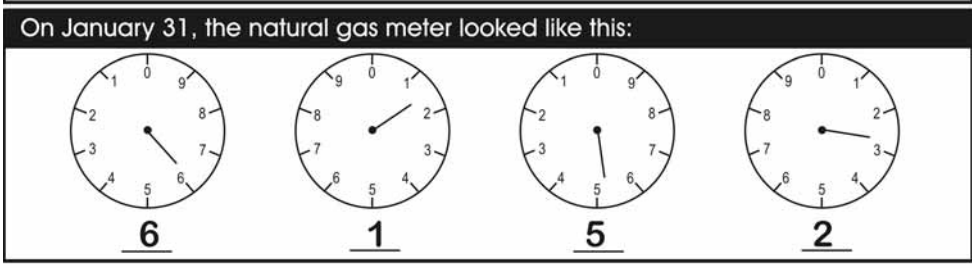
REAL LIFE OPTION: Measure the amount of electricity used at school for a one-hour period at the same time every day for a week. Have a "No Power Hour" for the entire school, measure the electricity used, and compare.





January 31 reading = 43472
January 1 reading = – 26010
Electricity used = 17462 kWh X $0.11/kWh = $ 1920.82





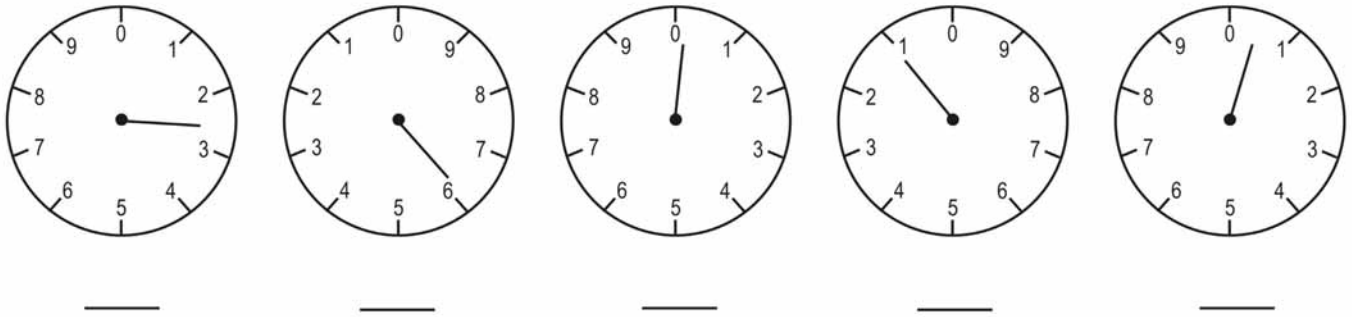
January 31 reading = 6152
January 1 reading = – 3528
Natural gas used = 2624 CCF = 2624 therm X $1.37/therm = $ 3594.88

Transparency 4-1

READING AN ELECTRIC METER

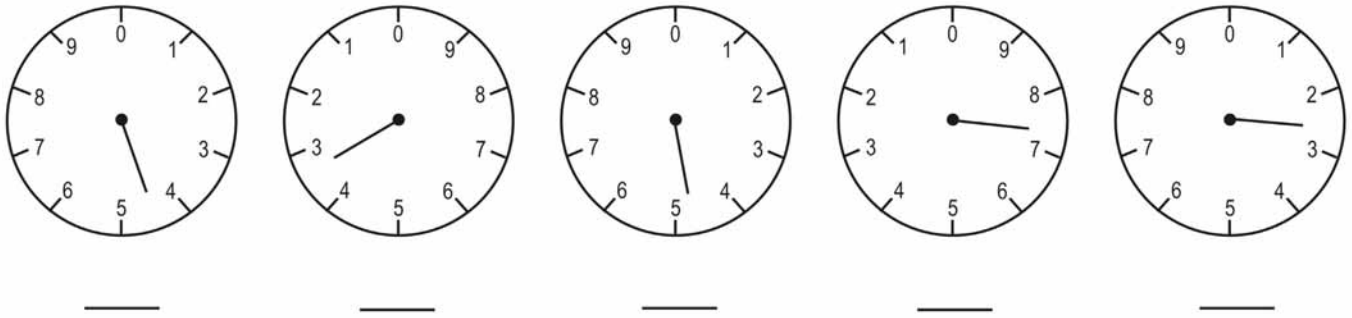
The meters below show the readings for the first and last days of January. See if you can determine how much electricity was used during the month. Read the meter dials and record the numbers on the lines below the dials. If the pointer is between two numbers, <u>always record the smaller number</u>.

On January 1, the electric meter looked like this:



_____ _____ _____ _____ _____

On January 31, the electric meter looked like this:



_____ _____ _____ _____ _____

How much electricity was used in January? Let's find out. Subtract the January 1 reading from the January 31 reading to find the kilowatt-hours (kWh) of electricity that were used during January.

January 31 reading = _____

January 1 reading = – _____

Electricity used = _____ **kWh**

If the power company charges eleven cents ($0.11) for every kilowatt-hour (kWh) of electricity that is used, what is the cost of the electricity that was used in January? Let's find out. Multiply the kilowatt-hours of electricity used by the cost per kilowatt-hour.

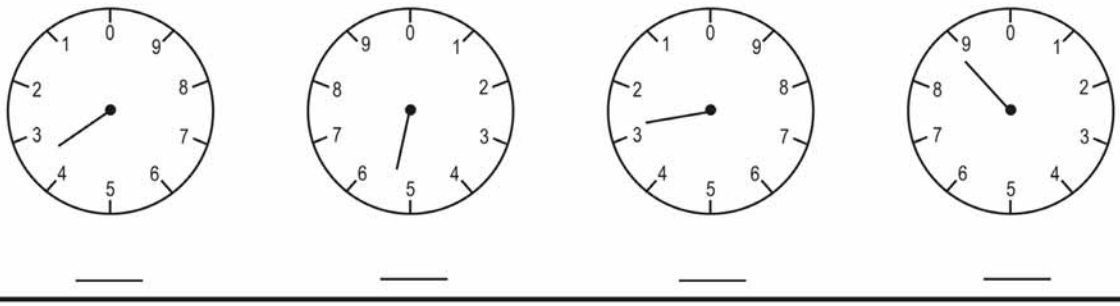
_____ **kWh X $0.11/kWh** = **$** _____

Transparency 4-2

READING A NATURAL GAS METER 4

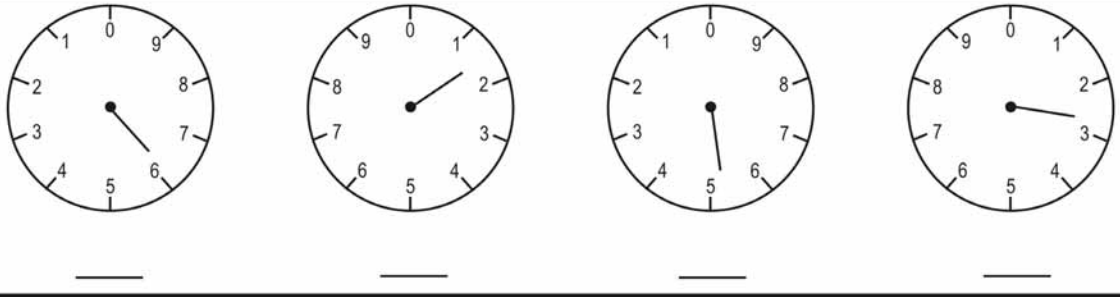
The natural gas meters below show the readings for the first and last days of January. See if you can determine how much natural gas was used during the month. Read the meter dials and record the numbers on the lines below the dials. If the pointer is between two numbers, always record the smaller number.

On January 1, the natural gas meter looked like this:



_____ _____ _____ _____

On January 31, the natural gas meter looked like this:



_____ _____ _____ _____

Natural gas is measured in CF or cubic feet—a measure of its volume—how much space it occupies. A cubic foot of natural gas is a small amount of fuel, so most gas meters measure natural gas in hundreds of cubic feet—or CCF. The first C means one hundred (from the Greek numbering system).

100 cubic feet = 100 CF = 1 CCF

How much natural gas was used in January? Let's find out. Subtract the January 1 reading from the January 31 reading to find the volume of natural gas that was used during January.

January 31 reading = _____

January 1 reading = **–** _____

Natural gas used = _____ **CCF**

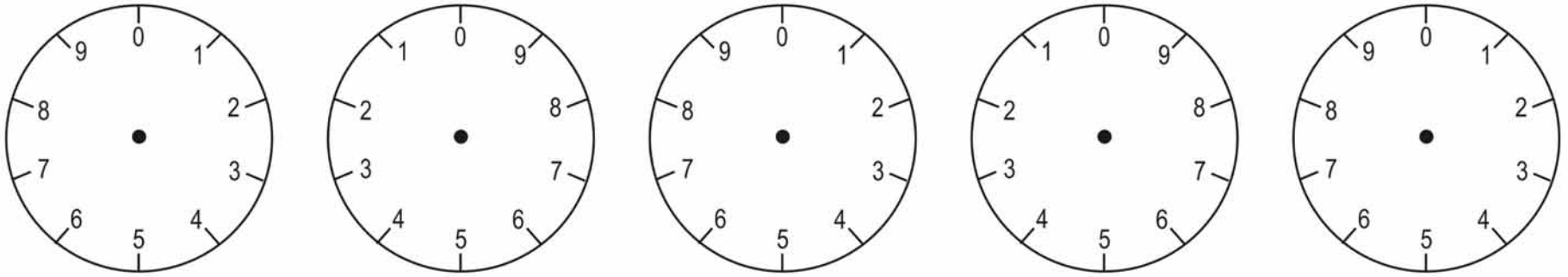
The meter measures the natural gas in CCF, but the natural gas company charges by the amount of heat energy the gas contains. Heat energy is measured in **therms**. One CCF of natural gas contains on average one therm of heat energy. If the gas company charges $1.37 for a therm of gas (the national average for residential customers in 2008), how much did the gas cost in January? (1 CCF = 1 therm)

_____ **CCF gas used =** _____ **therm of heat energy**

Cost = _____ **therm X $1.37/therm = $** _____

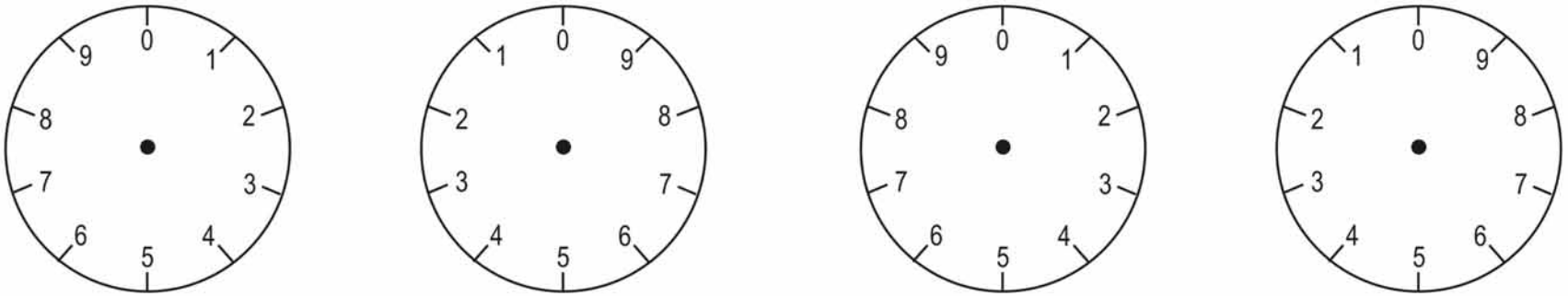
Transparency 4-3

SCHOOL ELECTRIC METER



_____ _____ _____ _____ _____

SCHOOL NATURAL GAS METER



_____ _____ _____ _____

LESSON 5: INSULATION & WEATHERIZATION

OVERVIEW: This lesson helps students understand the importance of insulation in reducing energy consumption. Students will learn how to reduce air infiltration using simple energy saving measures.

MATERIALS:

4 Radiation Can Sets	8 Thermometers	Pitcher
4 Insulating Materials	8 Rubber Bands	Timer*
Hot Water (120° – 150°F)*	4 Rolls of Masking Tape	* *not included*

TRANSPARENCY: Insulation Results 5-1

STUDENT GUIDE:
Insulation Investigation 5
Home Activity 5
Reflections 5
Connections 5

ENERGY SAVERS: Pages 4 – 9

HOME ACTION: Install electrical outlet and switchplate gaskets **with adult supervision.**

PREPARATION: Set up four lab stations—each with two radiation cans of the same color, 2 thermometers, 2 rubber bands, one of the insulating materials, and tape. Make sure you have a source for hot water, a pitcher to dispense it, and a timer.

PROCEDURE

INTRODUCE: The topic by explaining the concepts of insulation, air infiltration, and weatherization, and why they are important to energy conservation.

GO TO: Page 4 of the Energy Savers booklet.

DISCUSS: Using the diagram on page 4, discuss the areas of a home that should be insulated. Using the graph on page 9, have students identify ways air can escape from a school building.

GO TO: **Insulation Investigation 5** on page 32 of the Student Guide. Review the procedure with the students.

ASSIGN: Each work group to a lab station.

DISCUSS: The different insulating materials they will be investigating and have each group rank the materials from 1 to 4 with 1 being the best insulator.

LIST: The groups' hypotheses on the board.

INSTRUCT: The groups to insulate sides of one of their cans with the materials they have been provided.

FILL: All of the cans with exactly the same amount of hot water (approximately two-thirds full) and instruct the students to replace the tops and insert the thermometers according to the procedure.

BEGIN TIMING: When all of the groups are ready. Have the groups record the beginning temperatures, then call out the time at two minute intervals for them to record the temperatures of both cans.

CALCULATE: After 20 minutes, have the students calculate the difference between the beginning temperature and the ending temperature of each can and record it in the **Δ** column of the chart.

DISPLAY: **Insulation Results (5-1)** transparency and record the results of the groups.

COMPARE: The groups' hypotheses with the results.

DISCUSS: Variables that might have made the results unreliable—differing amounts of insulation, the tops and bottoms of the cans were not insulated, different people reading the thermometers, etc. On the bottom of the transparency, list ways the experiment could be redesigned to make it more reliable with input from the students.

INSTRUCT: The students to graph their results.

GO TO: **Home Activity 5** on page 33 of the Student Guide and review the assignment with the students.

ASSIGN: The activity and reading to the students and give them a completion date.

REMIND: Students to take home their gaskets, Student Guides, and Energy Savers booklets and to bring the guides back on the completion date. **SAFETY NOTE: Emphasize to students that they must have ADULT HELP to install gaskets.**

PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITY

REVIEW: The activity with the students and answer any questions they have.

DISCUSS: What the students learned from the activity.

ASK: How many students installed the outlet and switchplate gaskets. Encourage those who did not install the gaskets to do so.

EVALUATE: Have the students complete **Reflections 5** and **Connections 5** on pages 34-35 of the Student Guide.

Transparency 5-1

INSULATION RESULTS

TEAM	UNINSULATED Δ	INSULATED Δ
1. Material:		
2. Material:		
3. Material:		
4. Material:		

LESSON 6: HEATING AND COOLING

OVERVIEW: Heating and cooling systems in schools and homes use more energy than any other energy systems. This lesson will focus on learning to use these systems efficiently.

MATERIALS: 4 Student Thermometers

TRANSPARENCY: Thermostat Temperature Guide 6-1

STUDENT GUIDE: Temperature Investigation 6
Home Activity 6
Reflections 6
Connections 6

ENERGY SAVERS: Pages 10 – 15

HOME MEASURE: Thermostat Temperature Guide

PREPARATION: Prior to the lesson, arrange to have someone from the maintenance staff show the students the HVAC (Heating, Ventilation, and Air Conditioning) system and answer questions about the energy sources that fuel them. Schedule a time for students to visit their work areas.

PROCEDURE

INTRODUCE: The activity by discussing the importance of managing heating and cooling systems to save energy because these systems use more energy than any other systems in schools and homes.

ACTIVITY: Have the students inspect the school HVAC system with someone from the maintenance staff. Ask the maintenance person:

Which system is in operation?

What energy source fuels the heating system?

What energy source fuels the cooling system?

GO TO: **Temperature Investigation 6** on page 36 of the Student Guide. Direct students to the Thermostat Temperature Guide at the bottom of the page.

DISPLAY: **Thermostat Temperature Guide (6-1)** transparency and explain how to read it in both heating and cooling seasons.

REVIEW: The activity with the students and have them get into their groups. Provide each group with a student thermometer.

INSTRUCT: Students to complete the activity.

REVIEW: The results with the students using the transparency (6-1).

DISCUSS: Whether any action should be taken if temperatures are not within Energy Saving ranges.

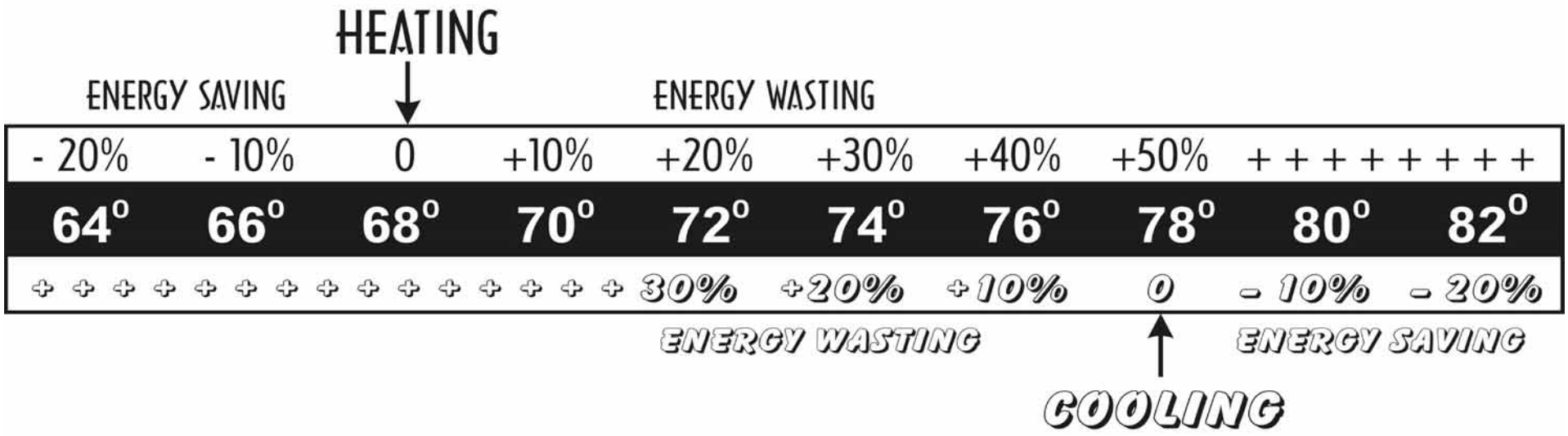
GO TO: **Home Activity 6** on page 37 of the Student Guide and review with the students.

ASSIGN: The activity and give students a completion date. Make sure each student takes a Thermostat Temperature Guide home, along with a Student Guide and Energy Savers booklet.

REVIEW: The activity upon completion and discuss with the students what they have learned.

EVALUATE: Have the students complete **Reflections 6** and **Connections 6** on pages 38-39 of the Student Guide.

TEMPERATURE GUIDE



Classroom:

Office:

Gymnasium:

Cafeteria:

Library:

LESSON 7: WATER HEATING

OVERVIEW: This lesson focuses on heating water and using hot water, the third largest energy cost in most homes.

MATERIALS: Flow Meter Bag and Hot Water Gauge (from Home Kit)

TRANSPARENCIES:
EnergyGuide Label 7-1
Home Activity 7-2 Answer Key

STUDENT GUIDE:
Water Heating Investigation 7
Home Activity 7-1
Home Activity 7-2
Reflections 7
Connections 7

ENERGY SAVERS: Pages 16 – 17

HOME MEASURES:
Hot Water Gauge
Flow Meter Bag
Kitchen Sink Aerator
Bathroom Sink Aerator
Low Flow Showerhead
Teflon Tape

PREPARATION: Prior to the lesson, arrange to have someone from the maintenance staff show the students the water heating systems and answer questions about the energy sources that fuel them. Schedule a time for students to visit their work areas, making sure there are adults present to assist the teams. If there is no hot water source in an assigned work area, consider substituting other work areas for the students to use, such as janitorial closets, restrooms, etc.

Review instructions for the Hot Water Gauge and Flow Meter Bag (in Home Kit). Train the adult helpers in the operation of the equipment. **SAFETY NOTE: The Flow Bag should only be used to measure cold water. Make sure the adult helpers warn the students not to touch the hot water.**

PROCEDURE

INTRODUCE: The lesson by discussing how we heat water at school and home.

INSTRUCT: Students to read the introduction on page 16 of their Energy Savers booklets.

LIST: Ways hot water is used in schools and homes.

LIST: Ways to cut water-heating bills—use less hot water, turn down the water heater thermostat, insulate the water heater, use an energy efficient water heater. Emphasize ways to use less hot water—taking short showers instead of baths, running the dishwasher only when it is full, washing clothes in cold water, filling the sink when hand-washing dishes instead of washing under running water, etc.

DISPLAY: **EnergyGuide Label (7-1)** transparency and explain the information it includes.

INSPECT: The school's water heating system with someone from the maintenance staff, locating the EnergyGuide label and the thermostat.

ASK: The maintenance person the following questions:

What is the energy efficiency rating from the EnergyGuide label?
At what temperature is the thermostat set?
What energy source is used to fuel the water heating system?

INSTRUCT: The students to enter the information in the appropriate blanks on page 40 of the Student Guide—**Water Heating Investigation 7**.

REVIEW: The procedure for the rest of the investigation.

INSTRUCT: The students in the correct operation of the Hot Water Gauge and Flow Meter Bag.

DISTRIBUTE: One Hot Water Gauge and one Flow Meter Bag to each team. Make sure an adult is available at each work area to assist each team with the investigation.

INSTRUCT: The students to complete the investigation with their adult assistants.

REVIEW: Each team's data so that all students can record the data in their charts.

COMPARE: Actual water temperatures with recommended temperature.

DISCUSS: Whether any changes should be recommended based on the results of the discussion.

REVIEW: **Home Activity 7-1** and **Home Activity 7-2** on pages 41-42 of the Student Guide with the students.

DISPLAY: The two aerators, a low flow showerhead, and the Teflon tape from one of the home kits and explain how to install them and how they reduce water flow.

ASSIGN: The activities and give students a completion date.

REMIND: Students to take home their Student Guides, Energy Savers booklets, Hot Water Gauges, Flow Meter Bags, aerators, showerheads, and Teflon tape. **SAFETY NOTE: Warn students to follow instructions about hot water safety.**

PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITY

REVIEW: **Home Activity 7-1** with the students and answer any questions they have.

REVIEW: **Home Activity 7-2** with the students using the **Answer Key** transparency.

DISCUSS: What the students learned from the activities.

ASK: How many students installed the low flow showerheads and faucet aerators. Encourage those who did not install them to do so.

EVALUATE: Have the students complete **Reflections 7** and **Connections 7** on pages 43-44 of the Student Guide.

Based on standard U.S. Government tests

ENERGYGUIDE

Clothes Washer
Capacity: Standard

MAYTAG
Model(s)
MAH5500B

Compare the Energy Use of this Clothes Washer with Others Before You Buy.

This Model Uses
302 kWh/year

Energy use (kWh/year) range of all similar models

Uses Least Energy	Uses Most Energy
177	1298

kwh/year (kilowatt-hours per year) is a measure of energy (electricity) use.
Your utility company uses it to compute your bill. Only standard size clothes washers are used in this scale.

Clothes washers using more energy cost more to operate.
This model's estimated yearly operating cost is:

$33

Based on eight loads of clothes a week and a 2008 U.S. Government national average cost of $0.11 per kWh for electricity. Your actual operatingcost will vary depending on your local utility rates and your use of the product.

Important: Removal of this label before consumer purchase violates the Federal Trade Commission's Appliance Labeling Rule (16 C.F.R. Part 305)

Answer Key Transparency 7-2

HOME ACTIVITY 7-2 ANSWER KEY

COMPARING ENERGYGUIDE LABELS

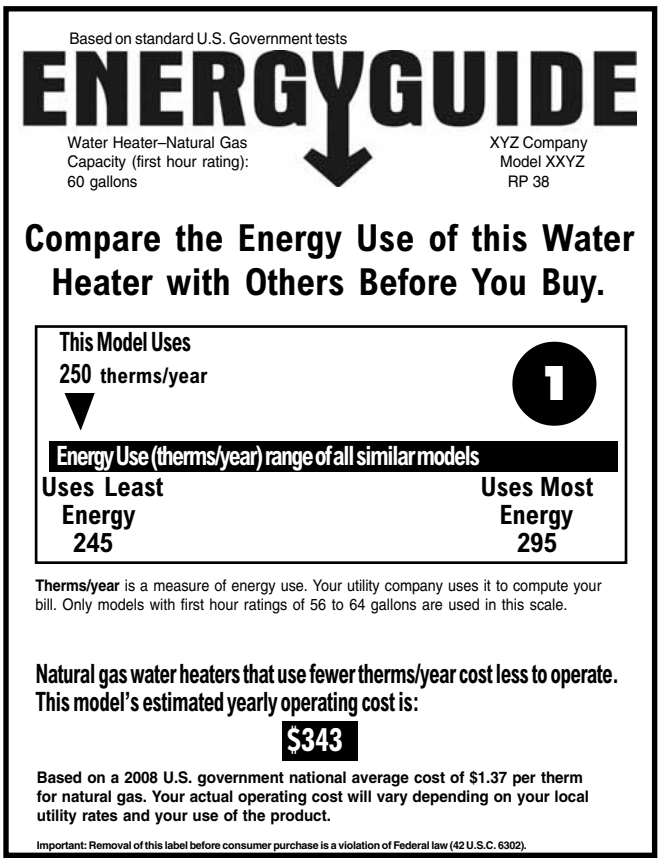
Your family needs to buy a new water heater. Water heaters usually last a long time—10 years or more—so you can save a lot of money on an energy-efficient one. Use the chart below to figure out which water heater to buy comparing the information on the EnergyGuide labels.

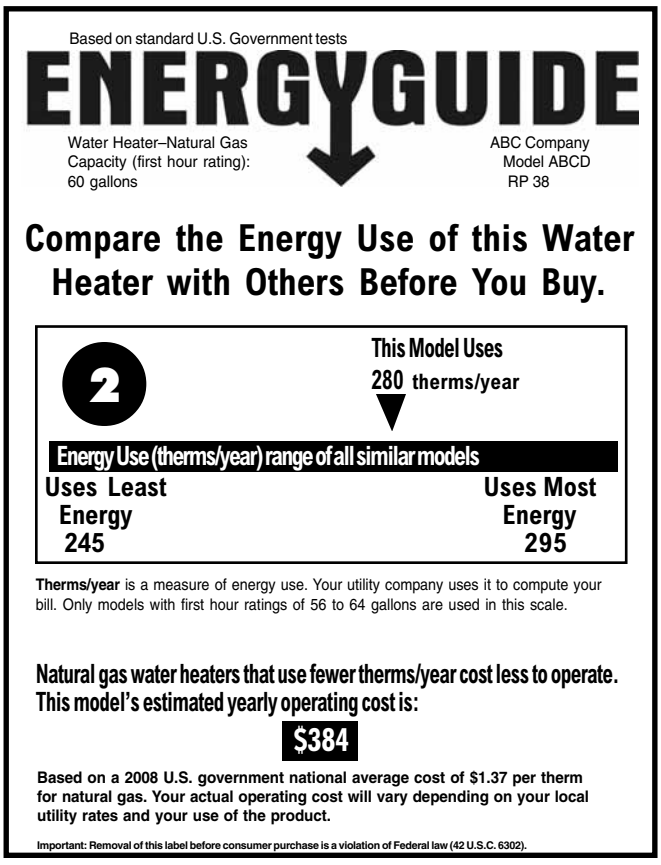
How many years will it take before you begin to save money? ***Four years***

How much money will you have saved after seven years? ***$162.00***

Water Heater 1: Purchase Price: $375.00 Water Heater 2: Purchase Price: $250.00

Water Heater 1	Expenses	Cost to date	Water Heater 2	Expenses	Cost to date
Purchase Price	*$375*	*$375*	Purchase Price	*$250*	*$250*
Year One	*$343*	*$718*	Year One	*$384*	*$634*
Year Two	*$343*	*$1061*	Year Two	*$384*	*$1018*
Year Three	*$343*	*$1404*	Year Three	*$384*	*$1402*
Year Four	*$343*	*$1747*	Year Four	*$384*	*$1786*
Year Five	*$343*	*$2090*	Year Five	*$384*	*$2170*
Year Six	*$343*	*$2433*	Year Six	*$384*	*$2554*
Year Seven	*$343*	*$2776*	Year Seven	*$384*	*$2938*





LESSON 8: WINDOWS

OVERVIEW: This lesson focuses on windows and how to reduce air infiltration.

MATERIALS: Pencils*, Tape*, Pieces of Tissue Paper (1" x 12")*

STUDENT GUIDE: Windows Investigation 8
Home Activity 8
Reflections 8
Connections 8

ENERGY SAVERS: Pages 18 – 19

PREPARATION: Cut 30 pieces of tissue paper 1" x 12"

PROCEDURE

INTRODUCE: The lesson by discussing the advantages of windows in buildings and their energy implications, including how they can reduce the need for artificial light and how poorly constructed windows can allow cold air infiltration in winter and heat infiltration in summer.

INSTRUCT: Students to read pages 18-19 in their Energy Savers booklets.

DISCUSS: The different types of windows and ways to prevent air infiltration through windows.

GO TO: **Windows Investigation 8** on page 45 of the Student Guide.

DISTRIBUTE: Pencils, tissue paper and tape to the students.

INSTRUCT: The students to tape the tissue paper to the ends of the pencils as shown in the diagram.

INSTRUCT: The students to examine the classroom windows and record their observations.

DISCUSS: The students' observations and elicit opinions of the energy efficiency of the windows.

INSTRUCT: The students to go to their work areas, examine the windows, and record their observations.

DISCUSS: The students' observations.

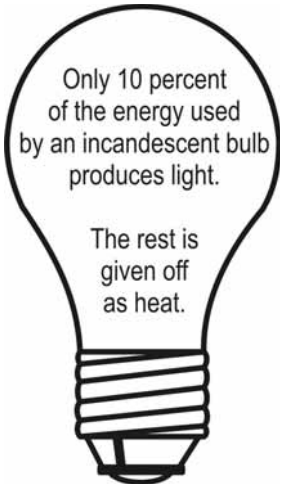
GO TO: **Home Activity 8** on page 46 of the Student Guide and review with the students.

ASSIGN: The activity and give students a completion date. Make sure each student takes home a pencil with tissue paper, a Student Guide and Energy Savers booklet.

REVIEW: The activity upon completion and discuss with the students what they have learned.

EVALUATE: Have the students complete **Reflections 8** and **Connections 8** on pages 47-48 of the Student Guide.

LESSON 9: LIGHTING



OVERVIEW: This lesson focuses on energy efficient lighting.

MATERIALS: Incandescent lightbulb (IL)
Compact fluorescent lightbulb (CFL)

TRANSPARENCIES: Lightbulb Packaging 9-1
Cost of 10,000 Hours of Light—Comparing Lightbulbs 9-2

STUDENT GUIDE: Home Activity 9
Do the Math—10,000 Hours of Light 9
Cost of 10,000 Hours of Light 9
Reflections 9
Connections 9

ENERGY SAVERS: Pages 20 – 21

HOME MEASURES: Compact fluorescent lightbulbs
LED Nightlight

PROCEDURE

INTRODUCE: The topic of lighting by discussing the many uses of lighting and having students look at page 71 of their Student Guides to review the number of lightbulbs in their homes.

INSTRUCT: Students to note the types of lighting in the classroom.

ASK: **How is it different from the lighting they have at home?** Most lights in schools are fluorescent tubes. At home, incandescent and/or compact fluorescent bulbs are usually used.

EXPLAIN: That a compact fluorescent or CFL uses the same technology as a fluorescent tube.

DISPLAY: The incandescent and compact fluorescent bulbs so the students can compare them visually.

DISPLAY: **Lightbulb Packaging (9-1)** transparency and explain the important measurements on the boxes:

Lumens—a measure of the amount of light a bulb produces
Watts—a measure of the amount of electricity a bulb uses
Life—the average length of time a bulb is expected to operate in hours

Also note the cost of the bulbs.

GO TO: Pages 49-50 of the Student Guide.

INSTRUCT: Students to use the information on the lightbulb package graphics on page 49 to complete the **Do the Math** activity on page 50 to determine purchase costs and energy costs of incandescent and compact fluorescent bulbs. The electricity cost of $0.11/kWh is the national average for residential consumers. To reinforce real life connections, use the residential electricity cost of your local utility.

EXPLAIN: Life cycle cost as the cost over the operating life of the bulb, not daily or monthly cost.

DISPLAY: **Cost of 10,000 Hours of Light (9-2)** transparency. Have students provide the data to complete the information on the transparency and determine the Life Cycle Savings using CFLs instead of ILs. Tell the students they will complete their forms with their families.

DISCUSS: The results and why so many people use incandescents when they could save so much money and energy by switching to CFLs.

REVIEW: **Home Activity 9** with the students.

ASSIGN: The activity and give students a completion date.

REMIND: Students to take home their Student Guides, Energy Savers booklets, and compact fluorescent lightbulbs and nightlight.

PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITY

REVIEW: **Home Activity 9** with the students and answer any questions they have.

DISCUSS: What the students learned from the activities.

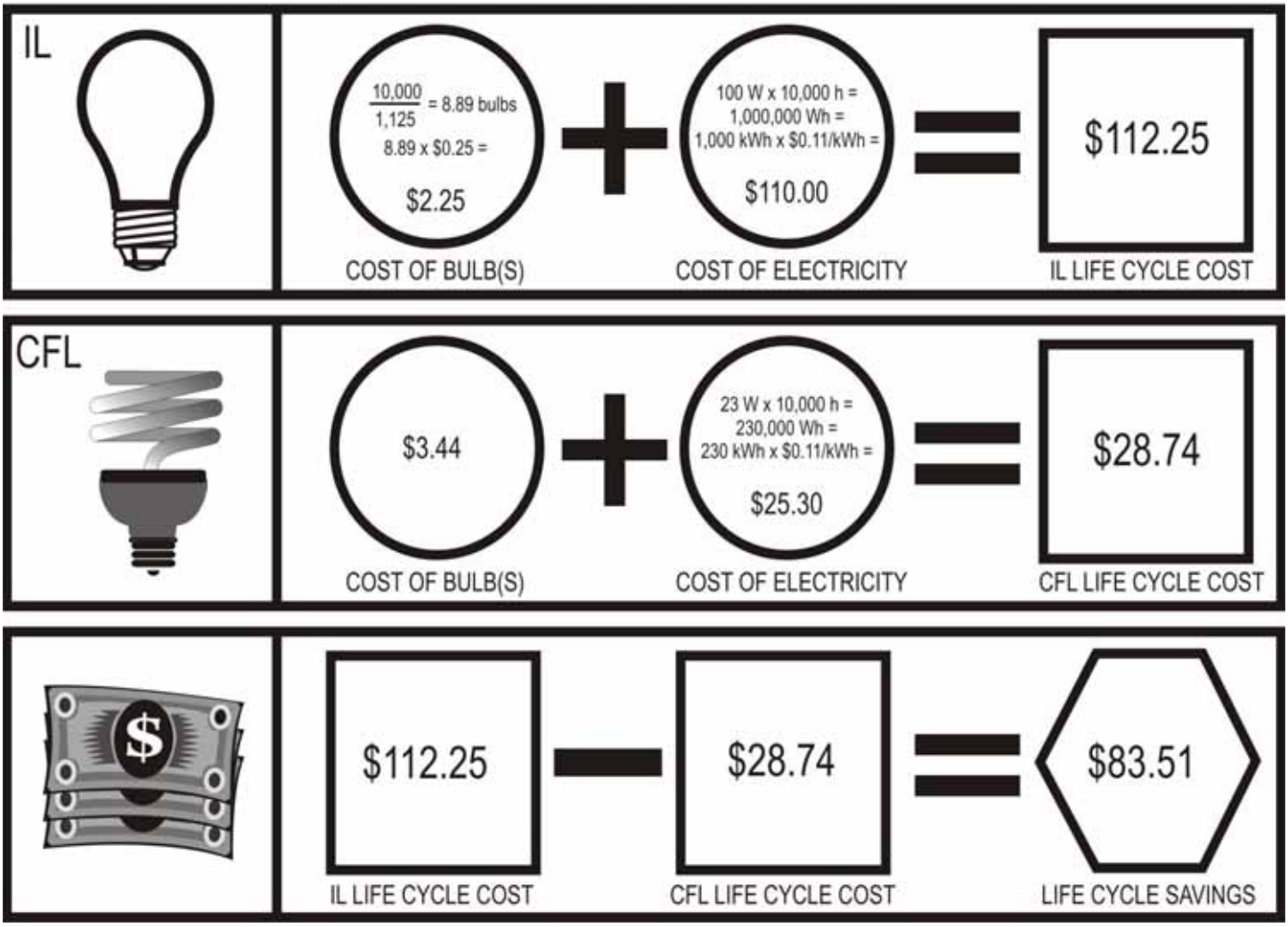
ASK: How many students installed the compact fluorescent lightbulbs and nightlight. Encourage those who did not install them to do so.

EVALUATE: Have the students complete **Reflections 9** and **Connections 9** on pages 52-53 of the Student Guide.

REAL LIFE OPTION: Have students research the cost of incandescent and compact fluorescent bulbs locally.

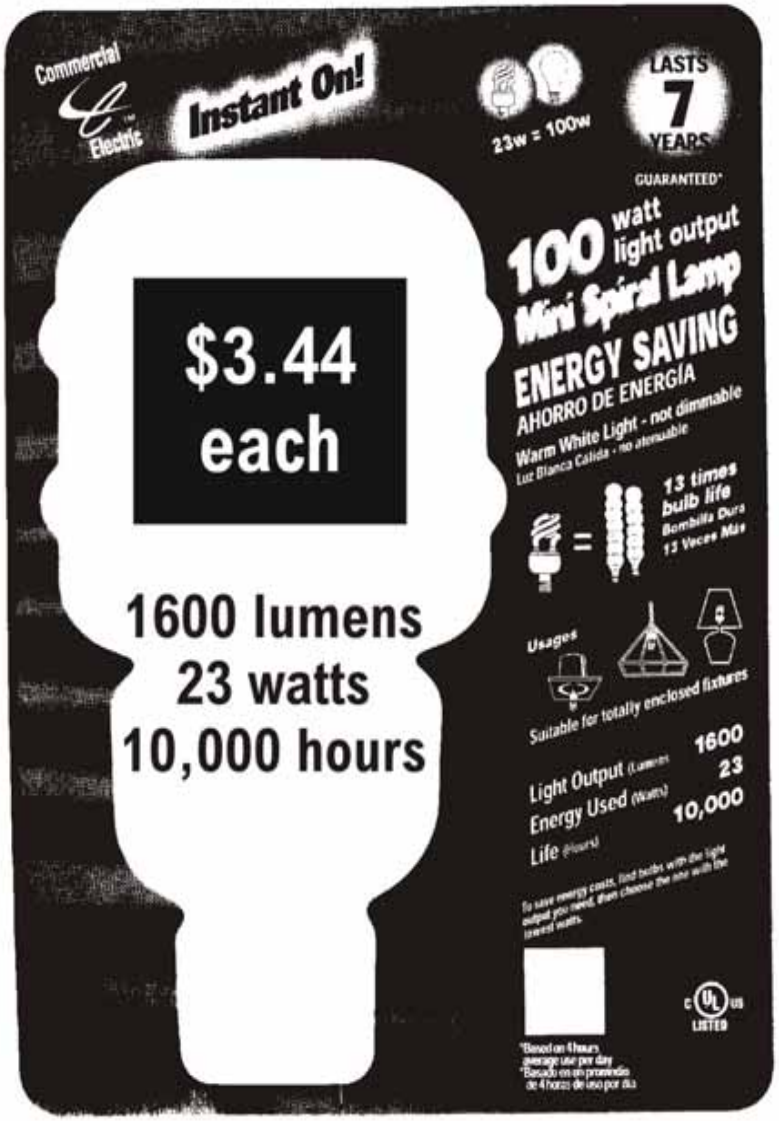
Have the students compare the cost of electricity from your local utility with the national average.

COST OF 10,000 HOURS OF LIGHT ANSWER KEY



INCANDESCENT

CFL

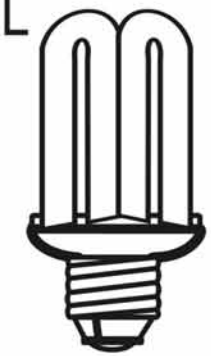


COST OF 10,000 HOURS OF LIGHT

IL

COST OF BULB(S) + COST OF ELECTRICITY = IL LIFE CYCLE COST

CFL



COST OF BULB(S) + COST OF ELECTRICITY = CFL LIFE CYCLE COST

IL LIFE CYCLE COST − CFL LIFE CYCLE COST = LIFE CYCLE SAVINGS

Transparency 9-2

LESSON 10: APPLIANCES AND MACHINES

OVERVIEW: This lesson examines the energy consumption of machines, appliances, and other electrical devices.

MATERIALS: Kill A Watt Monitor
Refrigerator Thermometer (in Home Kit)

STUDENT GUIDE: Measuring Electricity Use 10
Home Activity 10
Payback Periods 10

TRANSPARENCIES: Kill A Watt Monitor 10-1
Measuring Electricity Use Chart 10-2
EnergyGuide Label 7-1 (from page 35)

ENERGY SAVERS: Pages 22 – 30

HOME MEASURE: Refrigerator Thermometer

PREPARATION: Review the operating instructions of the Kill A Watt Monitor on page 43.

PROCEDURE

INTRODUCE: The topic by discussing all of the machines in the classroom that use electricity.

DISPLAY: **Kill A Watt Monitor (10-1)** transparency and explain what it does and how it is operated.

GO TO: **Measuring Electricity Use 10** on page 54 of the Student Guide. Review the activity with the students. Have the students decide as a class which three machines in the classroom they would like to investigate.

ASSIGN: Students in groups of two to measure the machines in the classroom for six-minute time periods following the procedure in the activity, then have them provide the data to the rest of the class.

DISPLAY: **Measuring Energy Use Chart (10-2)** transparency and review the example. Enter the first machine the students investigated and work through the math with the students. Have the students complete the remaining two machines on their own, then enter the data with student input.

ASSIGN: The work groups to measure one machine in each work area, one work group at a time, with the Kill-A-Watt meter. Instruct the student groups to interview someone in each work area to determine the number of hours the machine is in use each week.

DISPLAY: **Measuring Energy Use Chart (10-2)** transparency and enter the data from the work group machines.

DISCUSS: The results with the students.

GO TO: Page 22 of the **Energy Savers** booklet and have the students read the introduction to Appliances.

DISPLAY: **EnergyGuide Label (7-1)** transparency and review the information included.

REVIEW: **Home Activity 10** on pages 55–57 of the Student Guide.

ASSIGN: The activity and give students a completion date.

REMIND: Students to take home their Student Guides, Energy Savers booklets, and Refrigerator Thermometers.

PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITY

REVIEW: **Home Activity 10** with the students and answer any questions they have.

DISCUSS: What the students learned from the activities.

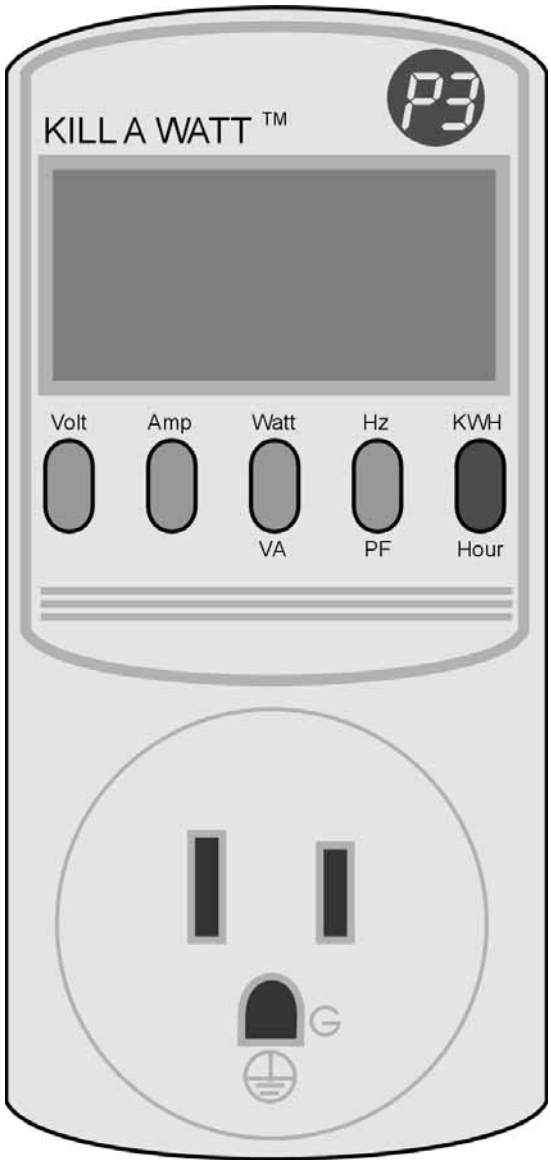
EVALUATE: Have the students complete **Reflections 10** and **Connections 10** on pages 58-59 of the Student Guide.

Kill A Watt™ Electricity Usage Monitor

The Kill A Watt™ monitor allows users to measure and monitor the power consumption of any standard electrical device. You can obtain instantaneous readings of voltage (volts), current (amps), line frequency (Hz), and electrical power being used (watts). You can also obtain the actual amount of power consumed in kilowatt-hours (kWh) by any electrical device over a period of time from one minute to 9,999 hours. A kilowatt is 1,000 watts.

Operating Instructions

1. Plug the Kill A Watt monitor into any standard grounded outlet or extension cord.
2. Plug the electrical device or appliance to be tested into the **AC Power Outlet Receptacle** of the Kill A Watt monitor.
3. The **LCD** displays all meter readings. The unit will begin to accumulate data and powered duration time as soon as the power is applied.
4. Press the **Volt** button to display the voltage (volts) reading.
5. Press the **Amp** button to display the current (amps) reading.
6. The **Watt** and **VA** button is a toggle function key. Press the button once to display the Watt reading; press the button again to display the VA (volts x amps) reading. The Watt reading, not the VA reading, is the value used to calculate kWh consumption.
7. The **Hz** and **PF** button is a toggle function key. Press the button once to display the Frequency (Hz) reading; press the button again to display the Power Factor (PF) reading.
8. The **KWH** and **Hour** button is a toggle function key. Press the button once to display the cumulative energy consumption. Press the button again to display the cumulative time elapsed since power was applied.

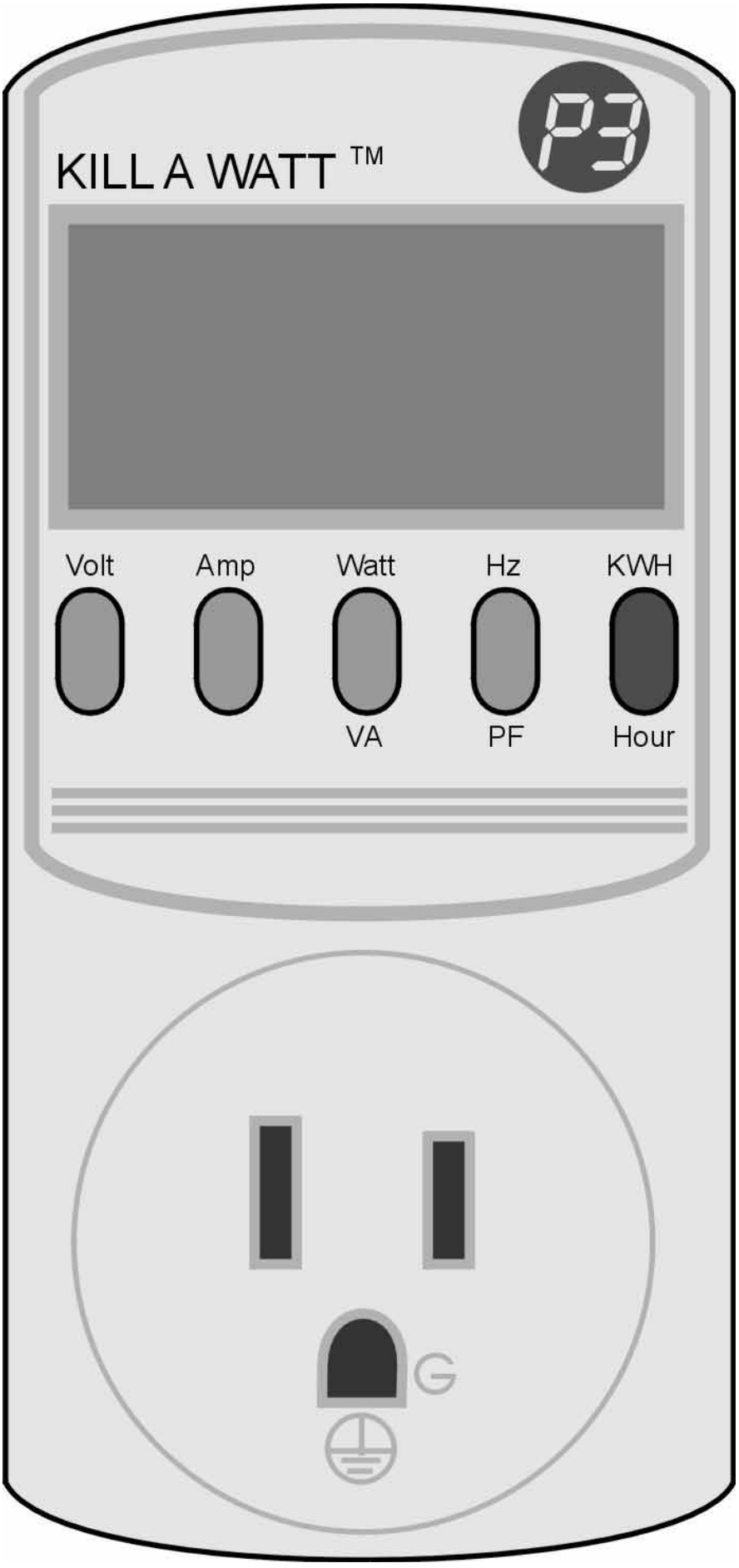


What is Power Factor?

The formula **Volts x Amps = Watts** is used to find the energy consumption of an electrical device. Many AC devices, however, such as motors and magnetic ballasts, do not use all of the power provided to them. The Power Factor (PF) has a value equal to or less than one, and is used to account for this phenomenon. To determine the actual power consumed by an AC device, the following formula is used:

Volts x Amps x PF = Watts Consumed

Transparency 10-1



MEASURING ENERGY USE CHART

Electrical Device	Watts 6 min	Watts 60 min	kW 1 hour	Hours per Week	Hours per Year	kWh per Year	Rate $ / kWh	Yearly Cost
Computer Monitor	*24 W*	*240 W*	*0.24 kW*	*40 h*	*1600 h*	*384 kWh*	*$0.10*	*$38.40*

LESSON 11: WHAT WE HAVE LEARNED

OVERVIEW: Students review what they have learned and what changes they have made to use less energy at school and at home.

STUDENT GUIDE: Your Family Rating 11
Home Activity 11-1
Home Activity 11-2
Connections 11
Post-Survey

PROCEDURE

INSTRUCT: The students to remove **Home Activity 3-1** on page 71 of the Student Guide. Collect these to send to NEED for evaluation.

REVIEW: **YOUR FAMILY RATING 11** on page 60 of Student Guide.

INSTRUCT: The students to complete the activity.

DISCUSS: With the students their feelings about their families' ratings and their ideas for saving energy.

ENCOURAGE: Students to share their results and their plans with their families.

REVIEW: **Home Activity 11-1** on page 69 and **Home Activity 11-2** on page 67 with the students.

ASSIGN: The activities and give students a completion date. Emphasize the importance of completing and returning these activities.

REMIND: Students to take home their Student Guides.

PROCEDURE AFTER STUDENTS COMPLETE AND RETURN THE ACTIVITIES

DISCUSS: What the students learned from the unit and what they think their families learned.

DISCUSS: The successful installation and use of the home energy measures, as well as barriers to installation and use.

EVALUATE: Have the students complete **Connections 11** on page 61 of the Student Guide.

ACTIVITY: Have the students participate in a culminating activity to reinforce the knowledge they have acquired and teach others. Suggestions include NEED's Energy House or Energy Conservation Contract activities; designing and developing an Energy Expo to exhibit at a PTA meeting or the public library; designing and developing lessons to teach younger students; and writing and performing a play for the school.

PROCEDURE AFTER COMPLETION OF UNIT

GO TO: **Post-Survey** on page 65 of the Student Guide. Have the students complete the survey.

INSTRUCT: Students to remove the **Post-Survey**, **Home Activity 11-1** and **Home Activity 11-2** from pages 65, 69, and 67 of their Student Guides. Collect these to send to NEED for evaluation.

COMPLETE: The Unit Evaluation on page 47.

SEND: **Student Pre** and **Post Surveys**, **Home Activities 3-1**, **11-1**, and **11-2**, and the **Unit Evaluation** to NEED in the enclosed envelope to:

NEED Project
8408 Kao Circle
Manassas, VA 20110

SAVING ENERGY
Evaluation Form

NAME: _____ **SCHOOL:** _____

1. Did you conduct the entire unit?	**Yes**	**No**
2. Were the instructions clear and easy to follow?	**Yes**	**No**
3. Did the unit meet your academic objectives?	**Yes**	**No**
4. Were the activities age appropriate?	**Yes**	**No**
5. Were the allotted times sufficient to conduct the activities?	**Yes**	**No**
6. Were the activities easy to use?	**Yes**	**No**
7. Was the preparation time acceptable for the unit?	**Yes**	**No**
8. Were the students interested and motivated?	**Yes**	**No**
9. Was the energy content age appropriate?	**Yes**	**No**
10. Would you conduct the unit again?	**Yes**	**No**

How would you rate the unit overall?

How would your students rate the unit overall?

What would make the unit more useful to you?

Other Comments:

NEED National Sponsors and Partners

American Association of Blacks in Energy
American Electric Power
American Electric Power Foundation
American Petroleum Institute
American Solar Energy Society
American Wind Energy Association
Aramco Services Company
Areva
Armstrong Energy Corporation
Association of Desk & Derrick Clubs
All Wild About Kentucky's Environment
Robert L. Bayless, Producer, LLC
BP Foundation
BP
BP Alaska
BP Solar
Bureau of Land Management – U.S. Department of the Interior
C&E Operators
Cape and Islands Self Reliance
Cape Cod Cooperative Extension
Cape Light Compact–Massachusetts
L.J. and Wilma Carr
Center for the Advancement of Process Technology–College of the Mainland–TX
Chesapeake Public Schools–VA
Chesterfield County Public Schools–VA
Chevron
Chevron Energy Solutions
ComEd
ConEd Solutions
ConocoPhillips
Council on Foreign Relations
CPS Energy
Cypress-Fairbanks Independent School District–TX
Dart Foundation
Desk and Derrick of Roswell, NM
Dominion
Dominion Foundation
Duke Energy
EDF
East Kentucky Power
El Paso Foundation
EnCana
Energy Information Administration – U.S. Department of Energy
Energy Training Solutions
Energy and Mineral Law Foundation
Energy Solutions Foundation
Equitable Resources
Escambia County School District–FL
FPL Energy Encounter–FL
First Roswell Company
Florida Department of Environmental Protection
Foundation for Environmental Education
Georgia Environmental Facilities Authority
Guam Energy Office
Gulf Power
Halliburton Foundation
Gerald Harrington, Geologist
Houston Museum of Natural Science
Hydro Foundation for Research and Education
Idaho Department of Education
Illinois Clean Energy Community Foundation
Independent Petroleum Association of America
Independent Petroleum Association of New Mexico
Indiana Office of Energy and Defense Development
Interstate Renewable Energy Council
Iowa Energy Center
Kentucky Clean Fuels Coalition
Kentucky Department of Energy Development and Independence
Kentucky Oil and Gas Association
Kentucky Propane Education and Research Council
Kentucky River Properties LLC
Kentucky Utilities Company
Keyspan
KidWind
Lenfest Foundation
Llano Land and Exploration
Long Island Power Authority–NY
Louisville Gas and Electric Company
Maine Energy Education Project
Maine Public Service Company
Marianas Islands Energy Office
Maryland Energy Administration
Massachusetts Division of Energy Resources
Michigan Energy Office
Michigan Oil and Gas Producers Education Foundation
Minerals Management Service – U.S. Department of the Interior
Mississippi Development Authority–Energy Division
Montana Energy Education Council
Narragansett Electric – A National Grid Company
NASA Educator Resource Center–WV
National Alternative Fuels Training Center–West Virginia University
National Association of State Energy Officials
National Association of State Universities and Land Grant Colleges
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
Nebraska Public Power District
New Jersey Department of Environmental Protection
New York Power Authority
New Mexico Oil Corporation
New Mexico Landman's Association
North Carolina Department of Administration–State Energy Office
Offshore Energy Center/Ocean Star/ OEC Society
Offshore Technology Conference
Ohio Energy Project
Pacific Gas and Electric Company
PECO
Petroleum Equipment Suppliers Association
Poudre School District–CO
Puerto Rico Energy Affairs Administration
Puget Sound Energy
Roswell Climate Change Committee
Roswell Geological Society
Rhode Island State Energy Office
Sacramento Municipal Utility District
Saudi Aramco
Sentech, Inc.
Shell
Snohomish County Public Utility District–WA
Society of Petroleum Engineers
David Sorenson
Southern Company
Southern LNG
Southwest Gas
Spring Branch Independent School District–TX
Tennessee Department of Economic and Community Development–Energy Division
Toyota
TransOptions, Inc.
TXU Energy
United Technologies
University of Nevada–Las Vegas, NV
United Illuminating Company
U.S. Environmental Protection Agency
U.S. Department of Energy
U.S. Department of Energy–Hydrogen, Fuel Cells and Infrastructure Technologies
U.S. Department of Energy – Wind for Schools
Virgin Islands Energy Office
Virginia Department of Mines, Minerals and Energy
Virginia Department of Education
Virginia General Assembly
Wake County Public Schools–NC
Washington and Lee University
Western Kentucky Science Alliance
W. Plack Carr Company
Yates Petroleum